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American Potato Journal

PUBLISHED BY

THE POTATO ASSOCIATION OF AMERICA

LANCASTER, PA. NEW BRUNSWICK, N. J.

THE JOURNAL

Your Secretary accepted the editorship of the AMERICAN POTATO JOURNAL last February. Since then we have passed through rather trying times. We are pleased to be able to report that the financial condition of the JOURNAL is sound but at the same time we are not in a condition of affluence! We have found it difficult to sell advertising space, we have, however, been fortunate in our attempts in this direction and our readers are urged to patronize the concerns that have supported the JOURNAL.

We hasten to assure you that we are by no means satisfied with the JOURNAL in its present form. It should be enlarged. The chief obstacle in the way of this, of course, is the fact that funds are not available. With the new year we hope to secure both new advertisers and new members. In order to accomplish this we must have your assistance. When you hear of a product which you feel the potato grower should know about, call the manufacturer's attention to the value of advertising in the JOURNAL. It is important also that the potato grower be acquainted with the JOURNAL. A number of new members were obtained this year but there are unquestionably others who could be interested in the Association. It is desirable that the state organizations enroll their members in the Potato Association of America, since by doing so both would be strengthened.

Next year we hope to make the JOURNAL of greater value to investigators and growers alike. At the present time, articles on the potato crop are published in a number of different publications. Few see all of these. In the future we hope to have the authors of these papers prepare a summary for the JOURNAL. These, in addition to the usual articles, and sectional notes will result in a JOURNAL which should be of real service to the industry.

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A PARTIALLY MASKED MOSAIC OF POTATOES

K. H. FERNOW

Cornell University, Ithaca, N. Y.

The Smooth and Russet Rural varieties of potato show mosaic so rarely under field conditions in New York State that inspectors and seed growers often assume that it is not necessary to make any attempt to record or control it in these varieties. Johnson (10) (p. 3) says: "The Rural appears to be comparatively free from marked symptoms of virus diseases." Nevertheless in some years high percentages of mosaic have been recorded, causing the rejection of fields of Rurals entered for seed certification, while other fields planted with the same stock showed no mosaic. Such circumstances led to a suspicion that mosaic might be much more abundant in these varieties than field inspections indicated. This suspicion was confirmed by the indexing of a quantity of Rurals during the winter of 1927–1928 when a considerable percentage of the indexed plants showed marked symptoms of mosaic.

Investigations reported in this paper have demonstrated that potato plants of the Smooth Rural and Russet Rural varieties frequently contain a virus which is more or less masked according to environmental conditions, but capable of causing a clearly recognizable disease on potato plants of the Green Mountain type.

The presence of a virus in plants which fail to show readily detectable symptoms has often been noted in scientific literature. Nishimura (11) reported that *Physalis alkekengi* was a symptomless carrier of tobacco mosaic. Holmes (6) has since shown that this plant is not always symptomless and that even when infected plants fail to show symptoms they still contain the virus. Holmes has also described the failure of certain other species to show symptoms when infected with tobacco mosaic.

Masking of mosaic in potatoes has been mentioned by many observers and its occurrence in warm seasons is commonly expected by inspectors, growers, and others. Johnson (8) showed that such masking of crinkle mosaic[1] on Bliss Triumph potatoes could be caused by

[1] This disease is called rugose mosaic in an early publication (15) but in a later paper (10) the statement is made that the disease was incorrectly designated and should be known as crinkle mosaic.

temperatures above 20° C. Tompkins (15) further showed that temperatures of 28° C. for only 2 hours a day would cause this disease to be masked in the new growth.

Johnson (9) working in Wisconsin, reported a virus disease produced on tobacco by juice from apparently healthy Bliss Triumph potatoes. Fernow (3) working in New York with Green Mountain potatoes found that what is probably the same virus was capable of causing a mosaic on *Nicandra physallodes, Datura Stramonium, Lycopersicum esculentum* and *Nicotiana glutinosa* while showing no symptoms on potato. This virus has since been shown to be present in practically all individuals of most of the American potato varieties, although some European varieties seem to be free from it. Seedling potatoes do not contain the virus until they have been inoculated (3). On some European varieties it produces marked symptoms, usually of a necrotic type. Schultz (12) also reports a necrotic disease of certain seedlings caused by this virus.

This virus has been called by some the "healthy" potato virus and by others the "latent" virus. Neither name seems particularly appropriate but the second name is probably the less objectionable. The latent virus was no doubt present in most if not all of the plants used in these studies both in those called diseased and in those for convenience called healthy.

Atanasoff (1) showed that the varieties Ashleaf and Koksiaan exhibit no readily detectable symptoms of stipple-streak but may nevertheless serve as sources of inoculum.

Folsom (5) states that Irish Cobblers may carry leaf-rolling mosaic and that Rurals may carry either leaf rolling or mild mosaic without showing symptoms. Schultz and Folsom (13) (14) report transmission experiments to Green Mountain from "curly dwarf," "mosaic," "ruffle dwarf," and "dwarf" Smooth Rurals and Russet Rurals. These experiments were complicated by natural transmission in the open field from the inoculated plants to the adjoining controls, but seem to indicate that Rurals showing a diseased appearance may harbor leaf rolling and rugose mosaic. These authors note that Rurals which showed symptoms of mosaic in 1920 appeared healthy in 1921.

PREVALENCE OF THE DISEASE

An attempt was made to determine the prevalence of the mosaic disease noted in the greenhouse indexing of 1927–1928, by further indexing in the greenhouse. In table 1, data are given as to the number of sources indexed and the percentages found in each year.

In all cases the lots indexed were either certified seed or the progeny of certified seed. In analyzing the data only those plants were counted as mosaic in which the symptoms were clear enough to make diagnosis relatively certain. Since doubtful cases were disregarded,

TABLE 1.—*Mosaic found by indexing Rurals in greenhouse*

Year	Variety	Sources	No. tubers	Per cent Mosaic	
				Average	Maximum
1929	Smooth Rural	3	311	29	64
1929	Russet Rural	6	592	2	6
1930	Smooth Rural	11	1815	30	87
1930	Russet Rural	8	1222	5	20
1931	Smooth Rural	12	761	26	86
1931	Russet Rural	4	212	15	35
1932	Smooth Rural	11	909	33	83
1932	Russet Rural	2	181	4	9

it is felt that the actual percentages usually were considerably above those recorded. Two sources of Smooth Rurals and one of Russet Rurals were found to be almost free from mosaic.

It was at first thought that a low temperature would be favorable to mosaic detection and an attempt was made to keep the temperature around 14° to 16° C. In some cases good results were secured but in other cases it was found almost impossible to detect mosaic in lots grown at these temperatures while parts of the same and of other lots grown in a warmer greenhouse showed good differentiation.

It is felt that failure to obtain good results at the lower temperatures may have been due to slow growth caused by a combination of partial dormancy of the tubers, deficiency of light, and low temperature. Perhaps if seed pieces were used in which the dormancy was thoroughly broken and if these were planted in fertile soil with an adequate exposure to light the symptoms of mosaic might be visible at the lower temperatures. This supposition was not tested by experiments under controlled conditions. Mosaic Rural plants grown at temperatures of about 25° or above did not show symptoms.

An attempt also was made to index stock out-of-doors by planting the index pieces about April 20. The index plot made a good growth but the leaves were badly injured by flea beetles. It was found impossible to detect mosaic, possibly because of the flea beetle injury.

Observations made on samples of New York potatoes planted in Bermuda in 1931 and 1932 show that mosaic may be detected in Rurals on that island. The results of the observations are shown in Table 2.

From the above discussion it is evident that mosaic is common in the Smooth Rurals of New York State although usually not detected

TABLE 2.—*Mosaic detected in Rurals planted in Bermuda*

Year	Variety	Sources	Per cent Mosaic	
			Average	Maximum
1931	Smooth Rural	11	18	43
1931	Russet Rural	11	8	38
1932	Smooth Rural	11	39	90
1932	Russet Rural	7	11	25

by field inspection. Apparently at least one-third of the tubers of this variety are affected. The disease seems somewhat less prevalent in the Russet Rural.

INOCULATION EXPERIMENTS

Inoculations were made by three different methods. In the needle-pricking method the inoculum was crushed in a mortar and applied with an implement made by fastening ten insect pins to the end of a pot label. The pins were dipped in the crushed inoculum and pricked into the plant to be inoculated. Usually the punctures were made in the axils of the leaves and several sets of punctures were made in each plant inoculated. In the rubbing method the leaf used as inoculum was held with a paper towel and rubbed repeatedly against leaves and stems of the plant to be inoculated. Grafts were made usually by cutting a slice from one side of the stem of each of the plants and then clamping the two cut stems together with spring clothespins (inarching). Sometimes a slice from one stem was placed against the wounded stem and held in place by clothespins, or the end of the stem was cut off and cleft and a wedge shaped scion from the plant used as inoculum inserted in the cleft and held in place by one or two clothespins. All three methods of grafting were found effective if all leaves were cut from the detached scions, but inarching was found to be the most certain. The results of the inoculation are shown in table 3. The denominator of each fraction represents the number of plants inoculated and the numerator the number of plants showing symptoms. In some cases symptoms showed during the current season but in most cases data were obtained from inspection of the progeny. The symptoms observed during the current season did not appear to be as distinctive as those exhibited by the progeny.

The symptoms shown by the progeny of the inoculated plants are sufficiently variable to lead to the suspicion that we are dealing not with one but with at least two and possibly three or four distinct viruses. It seems probable that some of the plants contained a mixture of viruses. The author has reached no definite conclusions with

TABLE 3.—*Inoculations on Green Mountains*

Date	Method	Inoculum Used				Uninoculated Checks
		Mosaic Rurals	Green Mountains with Mosaic from Rurals	Healthy Green Mountains	Healthy Rurals	
March 15, 1928	Needle pricks	3/4(a)			0/4	
Mar.–Apr., 1928	Grafting	17/17			2/5	0/6
Apr. 5, 1929(b)	Needle pricks	15/30	2/5	0/5	2/5	0/10
August 16, 1930	Rubbing	6/42			0/3	0/12
April, 1931	Grafting	24/24			2/4	
Feb.–Mar., 1932	Grafting	14/18			5/11	0/5

(a) In each fraction the denominator shows the number of plants inoculated and the numerator the number of plants showing symptoms.

(b) Only current season symptoms were recorded in the experiment of April 5, 1929.

regard to the identity of the virus concerned other than to state that the symptoms were in almost all cases distinctly different from those of mild and rugose mosaic, material of which was grown simultaneously. Authentic material of leaf-rolling mosaic and crinkle mosaic was not grown during the period of the experiments. The experiments of Schultz and Folsom (13) (14) might lead to the expectation that leaf-rolling mosaic was the disease involved. While the symptoms in many cases were similar to those of leaf-rolling mosaic the author is satisfied that in many cases either this virus was not present or if present was accompanied by other viruses.

In addition to the inoculations on Green Mountains recorded in table 3 inoculations by needle pricks were made February 22, 1928, on Bliss Triumph. Out of four plants inoculated with mosaic from Rurals all showed mosaic symptoms in the progeny. Out of four inoculated with naturally occurring Bliss Triumph mosaic (probably mild or crinkle mosaic) two showed symptoms, while the progeny of four plants not inoculated remained healthy. In connection with this experiment it was noted that the four plants inoculated with mosaic from Rurals showed little or no distortion of the leaves compared with the plants successfully inoculated with the naturally occurring mosaic. Green Mountains were inoculated with naturally occurring Green Mountain mosaic with the following results: March 15, 1928, 0/5, April 5, 1929, 8/15, August 16, 1930, 1/6.

In connection with the experiments started April, 1931, an attempt was made to classify the progeny plants into four distinct groups which were described as follows:

1. Leaves wrinkled but not curled, little distortion, little or no streaking, light-colored areas rather large with definite outlines. Few on a leaf.

2. Leaves ruffled and curled, light-colored areas distinct. Slight streaking.

3. Leaves wrinkled and more curled than in 1 and 2, light-colored areas less distinct, streaking.

4. Leaves markedly curled, turn yellow and drop off, severe streaking of leaf veins, petioles, and stems. Light-colored areas small, numerous, but less distinct than in 1, 2, and 3.

It was found that the classification on this basis might be somewhat dependent on the age of the plant, the size of the seed piece, etc., so that it was impossible to classify all the infected plants according to this system. The type of symptoms obtained and their variability are nevertheless indicated by the above descriptions.

The symptoms in the Rurals were observed to vary also, not only with the temperature and amount of light but within lots grown under the same conditions as well. In dealing with lots which were almost 100 per cent mosaic infected, it was found that there was a tendency to classify as healthy, plants which would have been called mosaic had they occurred in a comparatively healthy lot. It was found difficult to overcome this tendency due to uncertainty whether some of the symptoms observed might not be varietal or strain characteristics. It will be noted that Green Mountains inoculated with "healthy" Rurals not infrequently showed mosaic. It is thought that this was not due to lack of care in avoiding contamination but rather to the above tendency to classify as healthy, plants which were actually infected. This suggests that the percentage of mosaic commonly present in this variety is considerably higher than would appear from the indexing data alone.

The question may be raised whether the symptoms produced by grafting "mosaic" Rurals on Green Mountains are due to a virus actually detected by reason of symptoms produced on the Rurals, or whether the symptoms detected on the Rurals were an illusion having no relation to the presence or absence of the virus transmitted. In other words could the data on grafting recorded in table 3 under the columns headed "Mosaic Rurals" and "Healthy Rurals" have been drawn from the same population? To answer this question the results were tested by the X^2 method as described by Fisher (4). Of 59 Green Mountain plants grafted with "Mosaic" Rurals 55 became diseased and 4 remained healthy. Of 20 grafted with "Healthy" Rurals, 9 became diseased and 11 remained healthy. The X^2 was determined to be 22.58. Entering the table with $n = 1$ we find the odds considerably over 100 to one that the data were not drawn from one population.

EFFECT ON YIELD

Since it had been found practically impossible to detect the diseased plants in the open field, an attempt was made to establish

healthy and diseased plots by indexing tubers in the greenhouse. The results of such tests are given in table 4. In the 1929 test the indexed potatoes were divided into two lots, mosaic and healthy, and the tubers in each lot were cut into pieces averaging two ounces each. These were planted in alternate hills twenty inches apart in rows about 32 inches apart. Two hundred and seventy hills were planted. In table 4 the column headed "n" shows for each experiment the number of pairs of adjoining healthy and diseased plots which were available for comparison. The average loss was found by dividing the sum of the individual differences by n. The standard deviation (σ) was calculated from the formula $\sigma = \sqrt{\frac{\Sigma d^2}{n-1}}$. The odds were calculated according to Student's Method.

TABLE 4.—*Results of tests of reduction in yield caused by mosaic in Rurals.*

Year	Place	Length of plot in hills	n	Average yield of healthy—bu. per acre	Average loss bu. per acre	σ	Odds
1929	Ithaca	1	113	322	44.1	109.0	Large(e)
1929	Ithaca	1	39	322	90.0(a)	77.6	Large(e)
1929	Ithaca	1	49	322	17.1(b)	106.0	4:1
1930	Ithaca	20	5	200	28.8	21.2	36:1
1930	Fillmore	4	52	270	44.5(c)	41.5	Large(e)
1930	Fillmore	20	11	290	40.0(d)	31.0	826:1
1931	Ithaca	5	17	200	22.1	41.0	39:1

(a) Difference in yield between healthy hills and those recognized as mosaic in field inspection.

(b) Difference in yield between healthy hills and those considered mosaic in greenhouse test but not recognized in field inspection.

(c) Difference between adjoining tuber units of the same strain in the same row.

(d) Difference between adjacent rows of different strains of the same stock.

(e) "Large" indicates odds of more than 10,000 to 1.

During the growing season of 1929 the plants were examined and an attempt made to diagnose mosaic. In many cases it was found impossible to detect symptoms of mosaic and even in most of the cases in which plants were diagnosed as having mosaic, it was felt that it would have been impossible to do so if not aided by the knowledge that alternate hills should have the disease. At digging time each hill was weighed separately and the results treated statistically. In the computations, hills which at field inspection had appeared to be injured by cultural practices or environmental factors were omitted as were also hills next to missing hills. It was found that the average

loss for the plants shown by greenhouse test to be affected with mosaic was 44 bushels per acre. The hills which were recognized as having mosaic at the field inspection showed a loss of 90 bushels per acre, while those which could not be so recognized showed a loss of 17 bushels per acre. This might indicate that the tubers from which the latter plants were grown were wrongly diagnosed in the greenhouse. It is, however, also possible that accidental dwarfing of the plants influenced the diagnosis at the field inspection or that two diseases were detected in the greenhouse test, one of which had little or no effect on yield and could not be recognized at the field inspection while the other had a marked influence on yield and was recognizable at the field inspection. In the tests conducted at Ithaca in 1930 and 1931, it was found impossible to detect the disease by inspection in the field.

In 1930 a similar experiment was laid out at Ithaca using twenty hill plots planted in adjacent rows. Eight replications were planted, but three were destroyed by flooding. In this year at Fillmore it was found possible to detect mosaic in the field in a tuber unit plot belonging to H. L. Hodnett. A chart of this plot was made and at digging time 52 pairs of mosaic and healthy units of the same selection which adjoined in the row were weighed. In this comparison, units which adjoined a skip were not used. In the same plot it was noted that certain selections (consisting of 20 hill rows) were entirely diseased while the adjacent selection in the next row was entirely healthy. Eleven such pairs of rows were dug and the yields compared. In 1931 at Ithaca a plot was given planted with material indexed in the greenhouse, seventeen pairs of 5-hill plots being available. The results of the three-years' test seem to indicate that these diseases cause a loss of 22 to 44 bushels per acre, or 11 to 16 per cent. Since some cases may have occurred in which potatoes diagnosed as "Healthy" actually were diseased and *vice versa*, it is probable that the actual loss is rather towards the upper side of these limits. It is possible that with the single-hill plots in 1929, competition may have exaggerated the difference.

SUGGESTIONS FOR CONTROL

Since the loss in yield is relatively small compared with other virous diseases, the question may be raised whether the grower can afford to spend money on control. If the percentage of mosaic in the seed stock is relatively low (say not over 40 per cent) the answer may be in the negative. If, however, a grower planting ten acres and expecting a yield of 200 bushels per acre were to have 70 per cent mosaic in his seed stock he might expect to lose about 20 bushels per acre or a total of 200 bushels a year. If he could secure seed without mosaic he would be justified in spending nearly the value of the 200 bushels or about the total value of his planting stock especially when it is con-

sidered that the diseased seed will become less productive from year to year as the mosaic content increases while it will take some years for the new seed to acquire 70 per cent mosaic.

Possible methods of control are suggested below:

1. Roguing of seed plots.
2. Roguing of tuber unit plots.
3. Greenhouse indexing.
4. Selection of healthy hills or units.
5. Purchase of healthy seed.

Systematic experiments on control have not been laid out but some observations have been made.

Roguing of seed plots. Although the disease is usually impossible to recognize in the field, plots have sometimes been seen in which roguing of diseased hills would be possible and in one or two instances such roguing has been carried out by growers. Unfortunately no attempt has been made to compare the resulting seed with seed not so rogued.

Roguing of tuber units. In tuber unit plots mosaic has been observed and removed. In most cases the grower has been unable to recognize the diseased units. In one case, however, a grower has made a special effort for some years to rogue out mosaic units and has apparently been successful, as the indexing of this stock showed it to be unusually free from mosaic.

Greenhouse indexing. Few growers are in a position to make use of this method except by cooperating with some college or experiment station. Success in this method requires carefully controlled conditions and expert diagnosis. One difficulty is the slowness of these varieties of potatoes to germinate in the winter time. The use of ethylene chlorhydrin and potassium thiocyanate, while helpful, was not always found to give uniformly satisfactory results.

Selection of healthy hills or units. This method is probably unconsciously practiced wherever selection for yield is practiced. In the case mentioned previously in which mosaic was detected in a tuber unit plot and a yield test made, the mosaic units were not rogued but the healthy units were saved for next year's planting. The percentage of mosaic in this stock was 44 according to greenhouse indexing and 54 according to the field inspection. A sample of the presumably healthy units which were saved was indexed in the greenhouse before planting and showed 10 per cent mosaic. The units shown by greenhouse indexing to be mosaic were eliminated, and the remainder of the stock planted (including units not indexed). The following winter the stock was again indexed and showed 7 per cent mosaic.

Purchase of healthy stock. Growers whose seed stock was badly infected have been encouraged to purchase stock found by greenhouse

indexing to be relatively free from mosaic. One seed source was found in 1930 to be apparently free from mosaic. This seed developed yellow dwarf to such an extent as to make it undesirable, but related stock from the same original source was found two years later to have in one case 9 per cent and in another case 6 per cent mosaic and to be free enough from yellow dwarf to warrant its use. Another source found in 1930 to have 2 per cent mosaic has been maintained by the original grower by tuber unit roguing and has been widely planted by others, replacing stock which in one case showed 90 per cent mosaic.

In a few cases in which supposedly healthy stock was purchased subsequent tests showed high percentages of mosaic, indicating that either the original stock contained more mosaic than was supposed or that very rapid spread had occurred.

SUMMARY

Indexing of lots of Smooth and Russet Rurals in the greenhouse indicates that about a third of the tubers of these varieties is affected with a disease of the mosaic type which is ordinarily not detected in field inspections. Evidence obtained in inoculation experiments and other considerations suggest that this estimate is probably too low.

This disease can be transmitted to Green Mountain and Bliss Triumph, on which varieties it shows marked but variable symptoms indicating that several viruses may be involved..

The disease causes a serious reduction in yield even under conditions under which it cannot be detected, such losses amounting roughly to 30 bushels per acre or 15 per cent of the yield.

The control of the disease is held to be worth while. Chief reliance is to be placed on the planting of seed from sources found by greenhouse indexing to be relatively free from mosaic. The producers of such stock may in addition find it desirable to plant seed plots in tuber units, rogue these, and where possible to test the tubers before planting by indexing.

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UNIFORM SEED POTATO CERTIFICATION STANDARDS

WM. H. MARTIN

Since 1925 the Potato Association of America has been attempting to formulate standards for the certification of seed potatoes satisfactory to all the states. At first, the efforts were largely directed toward the adoption of uniform standards for the field inspections. A comparison of the regulations in effect in 1925 with those now in effect reveal that progress has been made. When certified seed is purchased the buyer has reasonable assurance of obtaining seed relatively free from disease. This is apparent from a consideration of the results of seed source tests conducted in New Jersey. In tests conducted fifteen years ago some lots of certified seed from certain states showed high disease counts while in more recent years sample lots of certified seed seldom show many diseased plants. This same situation exists in other sections. Our efforts in this direction have met with success. We cannot stop here, however.

At the present time one of the chief criticisms of certified seed is the appearance of the tubers. It is probably true that we have given too much stress to certain points in connection with certified seed potatoes. This applies in particular to our tolerances on both scab and rhizoctonia. The chief purpose of certification is to furnish the grower with high yielding seed reasonably free from those diseases which cannot be detected in the seed and for which there is no known control measure. This is not true of rhizoctonia and scab. It is an established fact that seed potatoes heavily infected with either of these

two diseases will give satisfactory results if the seed is properly disinfected before planting. Many potato growers feel, however, that certified seed potatoes should be free or at least reasonably so, from scab and rhizoctonia. It should be recalled that in a number of states a tolerance of only ten per cent is permitted for these two diseases. In view of this fact, when the grower receives seed with every tuber showing a considerable portion of the surface covered with rhizoctonia sclerotia, it is hardly to be wondered that he concludes that seed potato certification is not what it should be!

There are other points which need to be adjusted in our standards for the tuber inspection. Under the present system, with each state having different grade standards, there is no satisfactory way by which necessary adjustments may be made. In some of the southern states the growers purchase seed potatoes from as many as a half dozen states. Under the present system it is possible for these various lots of seed to vary greatly and still be within the requirements of the certification standards in the state from which the seed originated. In view of this fact the government inspector who is called in to adjust a claim is helpless. He has only the table stock grades as a basis and these do not apply to certified seed potatoes. We are sorely in need of a certified seed grade that is the same wherever seed potatoes are packed or delivered. When this is accomplished much of the difficulty which now confronts the certification authorities will be eliminated. Uniformity of grade standards will also enable the enactment of legislation to protect certified seed from fraud. Without uniform grade standards this cannot be accomplished.

With these thoughts in mind a conference was called at New Brunswick, New Jersey, March 29–30, 1932, to draw up uniform grade standards. This conference was attended by the following: K. W. Lauer, Harrisburg, Penna.; E. B. Tussing, Columbus, Ohio; Karl H. Fernow, Ithaca, N. Y.; R. A. Jehle, College Park, Md.; E. L. Newdick, Augusta, Me.; John Tucker, Ottawa, Canada; H. L. Bailey, Montpelier, Vt.; R. R. Pailthorp, U. S. D. A.; A. E. Mercker, U. S. D. A.; Paul B. Mott, Trenton, N. J.; Wm. H. Martin, New Brunswick, N. J.

The following general requirements for certification were agreed upon. It should be pointed out that these standards were made to conform as closely as possible to the United States grade standards for table stock.

Certified seed potatoes shall consist of potatoes of one variety, which are not badly misshapen; free from recognizable spindle tuber, freezing injury, deep scab, and soft rot. The potatoes shall be free from damage caused by dirt or other foreign matter, sunburn, second growth, growth cracks, cuts, bruises, hollow heart, sprouting, shriveling, stem end and other internal discoloration, dry rot, surface scab (moderate), surface scab (severe), rhizoctonia (moderate), rhizoctonia (severe), other diseases, insects or mechanical or other means.

Unless otherwise specified, the diameter of potatoes of round varieties shall be not less than $1\frac{7}{8}$ inches and of potatoes of long varieties not less than $1\frac{3}{4}$ inches and the weight of each potato shall not exceed 12 ounces.

Tolerances: In order to allow for variations incident to proper grading and handling, the following tolerances calculated on the basis of weight are provided:

	Per cent
Below minimum size	3
Above maximum size	6
Surface scab (moderate)	10
Surface scab (severe)	5
Rhizoctonia (moderate)	25
Rhizoctonia (severe)	5
Stem end or other internal discoloration	5
Sprouting	10
For requirements other than size, surface scab, rhizoctonia, stem end or other internal discoloration and sprouting	6

NOTE: (Of this 6% not more than one-sixth or 1% shall be allowed for soft rot, not more than one-sixth or 1% for recognizable spindle tuber, and not more than one-third or 2% for deep scab.)

The tolerances specified shall be placed on a container basis. However, any lot of seed potatoes shall be considered as meeting the requirements of the grade, if upon inspection, no sample from a single container in any lot is found to exceed the tolerances specified by more than double the amount allowed, provided that the entire lot shall average within the tolerances specified.

Definitions of Terms: As used in this grade:

"Not badly misshapen" means that the potatoes are not excessively pointed, dumb-bell shaped, excessively elongated, or otherwise ill-formed.

"Soft rot" means any soft or mushy condition of the tissue, such as slimy soft rot, wet fusarium, or wet breakdown following freezing injury or sunscald.

"Damage" means any injury or defect which materially affects the appearance or which materially injures the potato for seed purposes. Any one of the following defects or any combination of defects, the seriousness of which exceeds the maximum allowed for any one defect, shall be considered as damage:

(a) *Dirt or foreign matter* which materially affects the general appearance of the lot; a potato having an appreciable amount of caked dirt shall also be considered as damaged.

(b) *Sunburn* which causes dark discoloration and affects more than 10 per cent of the surface of the tuber. Light greening or light discoloration caused by exposure to light shall not be considered as damage.

(c) *Second growth* which has developed to such an extent as to noticeably affect the appearance of the potato.

(d) *Growth cracks* which are not shallow or not well healed.

(e) *Sprouting*, when the sprouts are over ¾ inch long.

(f) *Shriveling*, when the tuber is more than slightly shriveled.

(g) *Surface scab* (*moderate*), that is, surface scab which covers from 2% to not more than 10% of the surface in the aggregate.

(h) *Surface scab* (*severe*), that is, surface scab which covers more than 10% of the surface in the aggregate.

(i) *Rhizoctonia* (*moderate*), that is, rhizoctonia which covers from 2% to not more than 5% of the surface in the aggregate.

(j) *Rhizoctonia* (*severe*), that is, rhizoctonia which covers more than 5% of the surface in the aggregate.

(k) *Stem end discoloration* which extends over ¼ inch into the flesh of the potato.

These standards were adopted at the last annual meeting of the Potato Association of America. Unfortunately, only a few states were represented at this meeting. In view of this fact the recommended standards are presented here for the information of the producer of seed potatoes as well as those in charge of the work of certification. Some states have already adopted these standards. It is hoped that as other states modify their certification requirements for 1934 they will have these suggestions in mind. This matter could no doubt be readily adjusted if it were possible to arrange for a meeting of those in charge of certification but, unfortunately, present conditions will not permit of this. This question will, of course, be discussed at the Boston meeting but it is doubtful if the Western states will be well represented. In view of this fact it is hoped that each state will adopt these or similar standards. With a little cooperation from each state there is no reason why we should not have uniform standards in the near future.

NOTES ON BORDEAUX MIXTURE

GEORGE E. SANDERS

Bowker Chemical Co.

The following notes cover certain observations on Bordeaux mixture, made over a period of eighteen years. They are presented with the thought that they might be of value to others who are interested in this, one of our most effective fungicides.

Excess lime in Bordeaux mixture for the control of early blight of potatoes: In 1919 we demonstrated that the use of a Bordeaux mixture prepared with an excess of lime was less likely to injure apple foliage than was the case where the Bordeaux mixture was prepared with equal amounts of copper sulfate and lime. Following this work with the apple, a series of spray tests was conducted in which the ratio of copper sulfate to hydrated lime varied from 1 to 0.5, to 1 to 5. In

this test, most effective control of the early blight disease and largest yields followed the use of a Bordeaux mixture made up with excess lime.

Modification of the Kedzie formula: This formula for the manufacture of Bordeaux mixture, developed by Kedzie of Michigan, calls for the addition of sodium arsenite to the Bordeaux mixture. Where improperly prepared, however, the combination results in the formation of calcium arsenite which, due to its unstability, frequently causes serious burning. We have found that this difficulty may be overcome by adding the sodium arsenite solution to the dilute copper sulfate solution, before the lime is added to complete the mixture.

Bordeaux mixture prepared in this manner is green in color and is much more adhesive than the standard mixture. In our tests it has proven to be superior from the standpoint of adhesiveness as well as in the control of insects and diseases.

In the preparation of this type of Bordeaux mixture, one quart of saturated sodium arsenite is added to each 100 gallons of a 10–10–100 mixture. The sodium arsenite should be diluted in a gallon or two of water and stirred thoroughly with the diluted copper sulfate solution. When this is done the lime may be added.

Instantaneous Bordeaux mixture: In 1917 we developed what we then named quick time Bordeaux mixture. This consisted of placing finely ground or finely crystallized copper sulfate either in the strainer or the tank and filling the sprayer two-thirds full with the agitator running. Hydrated lime was then added. More recently this process of making Bordeaux mixture has been more suitably named, Instant Bordeaux, by F. J. Schneiderhan of West Virginia. The instantaneous Bordeaux mixture has been used almost exclusively by the fruit growers in the Annapolis Valley of Nova Scotia since 1918 and is now being extensively used south to Virginia. It may be of interest to note that the studies leading to the development of the rapid method of preparing Bordeaux mixture resulted in 1918 in the development of the copper-lime dust.

This method of preparing Bordeaux mixture has proven to be entirely satisfactory provided, of course, satisfactory agitation is obtained. Where a traction sprayer is used a very poor type of Bordeaux mixture results and consequently should not be used with this type of machine.

Nutrients in Bordeaux mixture: Preliminary studies in 1918 and 1919 indicated that increased yields of potatoes followed the use of a spray material made up of copper sulfate neutralized with potassium carbonate and carrying a small amount of nitrate of soda and sodium phosphate. These studies were continued at Presque Isle, Maine, in 1932 in cooperation with Dr. Reiner Bonde of the Maine Agricultural Experiment Station. This experiment was conducted on plots receiv-

ing 1000 and 2000 pounds per acre of a 5–8–7 fertilizer mixture at the time the crop was planted. The plot receiving the ton application of fertilizer was sprayed with the standard 5–5–50 Bordeaux mixture. The plot receiving 1000 pounds of fertilizer received five applications of the same Bordeaux mixture plus monopotassium phosphate and urea. In all, 4.6 pounds of nitrogen, 6.9 pounds of phosphorus and 8.4 pounds of potassium per acre were applied during the season.

No injury was observed on the plot receiving the Bordeaux mixture carrying the plant nutrients and the yield of the two plots was approximately the same. It is impossible to draw conclusions at this time concerning the value of this practice but the results obtained are worth following up.

POTATOES FORTY YEARS AGO

J. B. R. DICKEY

We are apt to think that large yields of potatoes are a comparatively recent development and the production methods have changed radically in late years. The files of the *American Agriculturist* for 1889 and 1890 give some interesting facts and figures regarding a potato growing contest which that paper conducted during those two seasons. This goes back farther than the memory of most present-day growers. The contest seems to have been very carefully conducted since the test acre was measured by a surveyor in the spring when entered and again when dug; all the potatoes on the acre were weighed and the figures witnessed and sworn to.

Blight was reported very severe both seasons save in Maine. In 1890, the average acre yield for the United States was but 57.5 bushels. Charles B. Coy, of Presque Isle, Maine, grew 738 bushels per acre in 1889, winning the grand prize of $500 in gold offered by the *Agriculturist* and also $600 in gold offered by the Bowker Fertilizer Company for the largest crop grown with their fertilizer. Potatoes sold that year for about $1.00 per barrel of 11 pecks so that the crop was valued at $255.00. The cost including interest on land and harvesting was computed at $95 per acre.

The crop was grown without manure on a six-year-old timothy sod, plowed in fall and replowed in the spring. Eleven hundred pounds of, approximately, a 4–8–5 fertilizer was applied in the row by hand and mixed with hoes and 900 pounds additional fertilizer was applied by hand in June and "hoed in around each plant." The rows were 33 inches apart and seed dropped 12 inches in the row. The seed was green sprouted, sprinkled with land plaster and covered two to three inches in furrows, which must have been somewhat deeper since they were "leveled up at the second cultivation." The crop was hoed

twice and cultivated twice. Misses were replanted. The variety was Dakota Reds.

The second prize in 1889 went to Alfred Rose, of Pen Yan, New York, who grew 669 bushels per acre of Early Peruvian, Early Ontario and Sunlit Star, by planting eight inches by 17 inches. Mr. Rose grew a second crop of 361 bushels after the first crop was harvested, making a total for the season of 1030 bushels, but only the first crop was counted in the contest. There were 17 crops of over 400 bushels reported in 1889.

In looking for Pennsylvania growers, we find Mr. C. E. Shippe, Columbus, Warren County, who grew 336 bushels: varieties, White Elephant and Empire State. Also Frank Marvin, Matamoras, Pike County, with 328 bushels of White Stars. Capser Hiller, of Conestoga, Lancaster County, made 285 bushels and Warren L. Maris, of Springfield, Delaware County, 273 bushels of Mammoth Pear; Ira L. Hershey, Ebys, Lancaster County, 260 bushels of Dakota Reds and White Stars; Shooley & Clark, Luzerne, 206 bushels, and L. E. Barnes, Camptown, Bradford County, 202 bushels.

In 1890 the Grand Prize went to William J. Sturges, of Buffalo, Wyoming, with 974 bushels, a part of the crop being Rural New Yorker No. 2. These potatoes were irrigated and were grown on almost virgin soil without either manure or commercial fertilizer. Seed planted eight inches by 30 inches. A grower in Colorado came in second with 847 bushels and a Maine man third with 745 bushels of Dakota Reds. There were 22 crops of over 400 bushels in 1890, the majority of them in Maine.

Pennsylvania was represented in the 1890 contest by G. B. Schooley, of Luzerne, with 506 bushels of a variety called Polaris. C. E. Shippe, of Warren County, again was mentioned, this time with 300 bushels of Empire State and Late Beauty of Hebron (a Rural). W. H. Nesbit, of Milton, Northumberland County, reported 259 bushels of Early Rose.

In 1889 Joseph A. Dilatush, of Robbinsville, New Jersey, raised 287 bushels of New Queen potatoes; Mahan & Son, of Vineland, produced 277 bushels, variety not given. Aaron Smock, of Marlboro, also produced 277 bushels of Peerless. In 1890, Samuel S. Colkitt, of Mount Holly, grew 325 bushels of the State of Maine potatoes while Aaron Smock grew 311 bushels of Green Mountains.

The contest seems to have been accompanied by keen rivalry between two fertilizer manufacturers, Mapes and Bowker. Even at that rather early date most of the growers appeared to use fertilizer on potatoes and, in the East, where the amount was given it was often close to a ton per acre. In ordinary farm practice it was no doubt much less.

Among the varieties mentioned, Dakota Red seemed popular, especially in Maine; Green Mountains, State of Maine and Empire State are frequently mentioned, all of which are the Green Mountain type. Many names are now entirely unfamiliar. Rurals are mentioned only once or twice.

SECTIONAL NOTES

NEBRASKA

The quality of the Nebraska potato crop this year is far above average. Ample moisture, low temperatures, and a late fall produced an excellent crop. Color of the triumphs is very good, the size runs from medium to large, some potatoes being too large for either table or seed. The cool weather produced excellent type.

Yields probably averaged twenty-five per cent above normal, considering one hundred bushels per acre as a normal yield. Some fields in the dry land territory yielded as high as 240 bushels but many fields did not have the yielding capacity due to poor stands. Some very poor yields resulted because of hail.

Harvesting conditions were ideal and the certified potato crop has gone to storage in the best possible condition. Most growers were extremely careful in handling their crop from the fields to the storage and have gotten it into storage with a minimum of bruises and feathering. The usual amount of bruising is apparent in lots of potatoes that were carelessly handled.

The fall has been extremely warm. It has been difficult to keep storage cellars cool. Some dry rotting in excessively bruised potatoes has been reported. The last few days have been cool and it is now possible to check this trouble through proper control of temperature.

Table stock prices have been disappointing to growers and very few have been selling since the distress shipments of early fall were cleaned up. These shipments represented potatoes for which growers did not have adequate storage or sales and were made to cover harvesting expenses. Earlier in the season there was evidence of an above normal demand for seed stock from the Southern states but this demand is decidedly quiet at this time and will probably continue so until nearer planting time or until table stock starts advancing.—Wm. Morrow.

PENNSYLVANIA

The October estimated average yield for Pennsylvania was 104 bushels or about 10 bushels below the five year average.

In Eastern Pennsylvania well cared for and well sprayed fields yielded fairly well but not as well as a large vine growth promised. Many good fields died suddenly after a 12 to 14 inch rainfall in late

August. Some low spots were drowned and the tubers rotted. Unsprayed fields died in August and made comparatively low yields.

Central Pennsylvania and mountain counties have the largest and best crop for several years. Vines remained green in many cases until October 12 when there was a heavy frost. Some blight was observed where spraying was neglected or stopped too soon. Some rot was present in these fields but the digging season was fairly dry so that the disease was not serious.

It was too dry in western Pennsylvania to make a satisfactory crop save in a few small localities where fair yields were secured. Some crops in this section were almost a total failure.

The quality of the crop is good save for rather large size in some cases. The set was not heavy due to July drought; favorable growing weather came later. There is less second growth than has been the case for the past several years and the crop grades up well with very little hollow heart.

The crop has been apparently pushed on the market abnormally fast, resulting in a decline from a farm price of one dollar to 75 cents or less.

According to the November 1st estimate, the present potato crop in the United States will amount to approximately 317 million bushels compared to 357 million bushels in 1932 and 364 million bushels average for the past five years. Unless prospects improve materially this will be the smallest crop since 1916 when we had only 287 million bushels. In 1925, the next smallest crop, we had 299 million bushels.

Prices on the farm in Pennsylvania in 1916 increased from $1.30 in the fall to $2.53 in March and in 1925 the October price of $1.14 was soon more than doubled. There are, however, two factors in this connection which should not be forgotten. In 1916 farm prices were on a rapid upward climb. In 1925 also, times were good and prices were high. Speculation also had much to do with the rapid rise in 1925. We must also have in mind the fact that the per capita consumption of potatoes has been steadily declining due to substitution of other foods and changing food habits. Fifteen years ago the average per capita production was approximately 3.8 bushels, while for the last ten years it will not average much over 3.0 bushels. It has been easy to substitute other things for potatoes and this will be done more and more as the price of potatoes goes upward, particularly when times are bad and cash scarce.—J. B. R. DICKEY.

WISCONSIN

The present uncertain conditions in the trade no doubt will have an effect of slowing up potato shipments. In the face of the present price of 70 cents at loading stations, the better class of stock is being stored on the farm and in warehouses at potato shipping points. The

crop is generally short in most sections. Notwithstanding unusually severe conditions of the past season, we are surprised to find the quality generally improved over that of the 1932 season.

In a recent statement to the growers, the Wisconsin Potato Growers' Association has called attention to the unusually severe conditions of the past three seasons. It is the belief of many associated with the industry that these severe conditions, even though causing temporary losses, have directed special attention to the program of production, standardization and distribution in a manner not possible under more normal conditions.

The adaptation of certain varieties to soil and other varying factors in Wisconsin potato belts has become even more sharply defined. Interest in improved seed stocks has never been more general in the state. Plans for the distribution of improved seed in several counties are going forward. In this connection there is unusual interest also in a trial of the newer varieties recently introduced by the United States Department of Agriculture. Unusual attention has been given to certain maladies associated with the degeneration of some potato stocks. An impetus has also been given to investigations of potato scab as well as degeneration maladies and the influences associated with the development of these maladies and their control.—J. W. MILWARD.

MICHIGAN

The most recent estimate indicates a total production of approximately twenty million bushels, an average of eighty bushels per acre; an extremely low yield for the state. The November estimate, however, gave an increase of three bushels per acre yield over the October estimate. Yields were generally increased both in the northern and southern parts of the state, but did not greatly benefit from the late rains because of the extremely poor stands obtained this season. Practically all late planted stock, or potatoes planted after June 15, throughout the central part of the state averaged around 60% stands. Earlier plantings were uniformly better.

The Upper Peninsula of Michigan has the best yield this year, seventeen growers qualifying for the Three Hundred Bushel Club, two of them growing over five hundred bushels per acre. In the Southern Peninsula, only three growers qualified for this club.

Quality is fairly good in the north, but in the southern two-thirds of the state an extreme percentage of off-type potatoes resulted from the suspension of growth during July and August, followed by fairly good rains the latter part of the season. This, coupled with poor stands, accentuated the conditions. Some internal brown-spotting has been noted throughout the southern two-thirds of the state, but this is not as severe as in 1931.

Very few fields were rejected for certification this year during the field inspection. In the southern two-thirds of the Lower Peninsula, however, there were rejections because of off-type and scab. Stock, in general, is running rather small throughout the state. About 5% of the stock in the southern half of the Lower Peninsula was injured by frost on October 24.

Prices throughout central Michigan, bulk sales, have been running around 45 to 48 cents per bushel. Very few potatoes, however, have been moving at this price. Certified seed usually does not move at this time of year, but several truck loads of certified Irish Cobblers have already been sold at $2.00 per bushel in the Midland section, in eastern-central Michigan.—J. J. Bird.

OHIO

The Ohio Legislature at its last session passed a Standardization Bill for fruits and vegetables. The main points of this bill require that all fruit and vegetable packages be marked with the full name and address of the grower or firm; the state where the commodities are grown or packed or if the commodity is repacked, the state of origin must be shown; the net content by weight or numerical count, if they are not in a standard container; the grade according to the standards established by the state of Ohio, which in all cases, are the United States grades and commodities that come under the term of this act may be offered for sale in an ungraded condition or graded according to individual standards provided the term "ungraded" or "growers grade" is used.

This act has had its effect, for many growers in Ohio are now grading according to United States standards. Those who are not using the standard grades find that packages marked "growers grade" do not have much market value. All potatoes shipped into Ohio will need to be marked to meet the requirements of this bill. It may be a little confusing to shippers of certified seed but we hope to get some of these difficulties ironed out before the heavy movement of seed next spring.

Ohio has had exceedingly dry years since 1929. This past season, the drouth covered a larger portion of the state than any drouth in previous years. Because of the many dry years, growers are now showing a tremendous interest in irrigation and several crops were irrigated this past year.

The Cobbler crop in southern Ohio is extremely small with yields running from 75 to 100 bushels. One grower who irrigated his crop four times had a yield of 350 bushels. The Russet crop was materially improved by light rains this fall accompanied by more favorable weather. While the yields are not large, many fields are running from 200 to 300 bushels per acre. One irrigated crop of Russets made

524 bushels. The quality is exceptionally good and tubers do not show as much second growth and dumb-bells as in previous years. Our drouth started extremely early. The plants did not grow much until the late fall rains.

The price in Ohio started to drop in July and has probably hit its low mark as there is a tendency now for the price to raise because of more inquiry and a better demand for potatoes this past week. Much of the poor quality has moved on the market. Growers are selling from 90 cents to $1.00 a bushel for U. S. No. 1 potatoes, while "growers grade" generally bring from 70 to 80 cents. There is a tendency for growers to hold for higher prices. There are more potatoes in storage in Ohio this year than there has been in any previous year. Many storages were constructed during the digging season.

Probably some of this "bullishness" is due to the effort of the growers in Ohio to stabilize prices. At a State Potato Meeting held in September which included buyers and growers, it was decided to appoint a committee to work out plans for stabilizing potato marketing in this state. Five points were recommended by this committee. The first one, and the only one to be undertaken this year, was the collection and dissemination of market information, shipments, etc. Key men were appointed in all the larger potato counties to furnish price information at the farm. This is included with material that is available from shipping points and city markets. This information is broadcast twice a week on Tuesday and Friday over three stations in Ohio. It is believed that this has had a tendency to stabilize the price in Ohio and growers wherever possible have put their potatoes in storage which has cut down the early fall movement.—E. B. Tussing.

MINNESOTA

The 1933 growing season in Minnesota has been a rather hectic one from the standpoint of the potato grower. During the spring months, prospects for a fine crop prevailed with ideal temperatures and moisture conditions. Then the hottest and driest June in history descended upon us, which practically ruined the early crop in the sand land area. About the only potatoes that did not suffer extensively in this area were those on the peat bogs, although more or less scab developed on the driest of these bogs. July and August continued dry although not as hot as June, and the potatoes in the Red River Valley and the northeastern part of the state seemed to be at a standstill. However, cool nights prevailed, and each morning the fields had recovered sufficiently to stave off the effects of another dry day. Early fall rains and late frosts kept the vines green unusually late, so that instead of what appeared in August to be about 50% failure turned out to be in general a very fair crop. The quality runs from fair in some localities to excellent in others, and the yields are

considerably better than anticipated earlier in the summer. Latest crop estimates put the Minnesota crop at a little more than 21,000,000 bushels, which is considerably below the average annual production for the state. Most of this reduction took place in the sand land areas and in the southern half of the state. 4372.75 acres of potatoes were inspected during the past summer of which 3754 acres qualified for certification.—A. G. TOLAAS.

PROGRAM

of

TWENTIETH ANNUAL MEETING

of

THE POTATO ASSOCIATION OF AMERICA

December 28 to 30, 1933

Thursday Morning Joint Session with the American Society of Agronomy, December 28, 9:00 A. M.; Room 3, Harvard Hall, Harvard University.

Symposium: *Field and Microchemical Methods for Determining Soil Deficiencies.* Leader, T. E. ODLAND, Rhode Island State College, Kingston, Rhode Island.

1. *The Use of Rapid Soil Tests in Research, Extension and Teaching.* (40 min.) C. H. SPURWAY, Michigan State College.
DISCUSSION (20 min.)—A. B. BEAUMONT, Massachusetts State College.

2. *Practical and Theoretical Considerations in Testing for Replaceable Potassium in Soils.* (40 min.) R. H. BRAY, University of Illinois.
DISCUSSION (20 min.)—G. N. HOFFER, N. V. Potash Company.

3. *A System of Determining the Nutritive Status of the Soil by Microchemical Tests of a Single Soil Extract.* (40 min.) M. F. MORGAN, Connecticut Agricultural Experiment Station.
DISCUSSION (20 min.)—M. A. LOCKWOOD, Eastern States Farmers' Exchange.

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1. *The Reliability and Interpretation of Results from Soil Tests as Used at Wisconsin.* (40 min.) E. TRUOG, University of Wisconsin.
DISCUSSION.

2. *Simple Chemical Tests on Plant Material as Aids in Determining Fertilizer Needs.* (40 min.) S. F. THORNTON, Indiana Agricultural Experiment Station.
DISCUSSION (20 min.)—J. B. SMITH, Rhode Island State College.

3. *Hydrogen-ion Concentration and Oxidation-reduction Intensity in Soils; Their Relation to the Growth of Plants and Soil Organisms.* (40 min.) L. G. WILLIS, North Carolina State College.
DISCUSSION.

Friday Morning Session, December 29, 9:30 A. M.; Room E-390, Biological Laboratories, Harvard University.

1. Address by the President. (15 min.) J. R. LIVERMORE, Cornell University, Ithaca, New York.

2. Report of the Secretary-Treasurer-Editor.

3. Appointment of Committees.

4. Report of the Seed Potato Certification Committee. (25 min.)

5. *The Activities of the International Commission for the Study of the Potato.* (15 min.) WILLIAM STUART, United States Department of Agriculture.

6. *The Effect of Soil Reaction on the Potato Plant.* (15 min.) ORA SMITH, Cornell University.

7. *Some Observations on the Sprout Development of Potato Tubers Exposed to Low Temperatures.* (20 min.) (Lantern.) R. R. HURST and H. L. MACLAREN, Charlottetown, Prince Edward Island.

8. *New Varieties of Potatoes.* (15 min.) F. J. STEVENSON, United States Department of Agriculture.

Friday Afternoon Session, December 29, 2:00 P. M.; Room E-390, Biological Laboratories.

1. *Potato Digger Equipment and Operation in Relation to Mechanical Injury.* (15 min.) E. V. HARDENBURG, Cornell University.

2. *Wire Worms and Their Injuries to the Potato.* (15 min.) G. F. MACLEOD, Cornell University.

3. *The Response of Potatoes to Magnesium under Various Soil Conditions.* (20 min.) T. E. ODLAND and H. C. KNOBLAUCH, Rhode Island State College.

4. *Magnesium in Potato Fertilizers in Aroostook County, Maine.* (15 min.) J. A. CHUCKA, Maine Agricultural Experiment Station.

5. *Fertilizer Studies on Long Island.* (15 min.) P. H. WESSELS, Long Island Vegetable Research Farm, Riverhead, Long Island, New York.

6. *Fertilizer Placement Studies with the Potato in 1933.* B. E. BROWN, United States Department of Agriculture.

Maine—J. A. Chucka, Agricultural Experiment Station.
Michigan—C. E. Millar, Agricultural Experiment Station.
New Jersey—Wm. H. Martin Agricultural Experiment Station.
Ohio—John Bushnell, Agricultural Experiment Station.
Virginia—W. O. Strong, Virginia Truck Experiment Station.

Saturday Morning Session, December 30, 9:30 A. M.; Room E-390, Biological Laboratories.

1. Business Meeting, Report of Committees and Election of Officers.

2. *Potatoes under Drouth Conditions.* (15 min.) DANIEL DEAN, Nichols, New York.

3. *The Cooperative Marketing Plan in Maine.* (15 min.) FRANK HUSSEY, Presque Isle, Maine.

4. *Developments in the Marketing of the Ohio Potato Crop.* (15 min.) E. B. TUSSING, Ohio State University.

5. *Cooperative Marketing as Applied to Agriculture.* (15 min.) J. W. BOULTER, Prince Edward Island, Canada.

6. *Marketing the New Jersey Potato Crop.* (15 min.) WM. H. MARTIN, New Jersey Agricultural Experiment Station.

7. DISCUSSION. *Adjusting Potato Production to Consumption Needs.*

Saturday Afternoon Joint Session with American Phytopathological Society, December 30, 1933, at 2:00 P. M.; Lecture Room, Biological Laboratories, Harvard University.

1. *Components of Potato Mild Mosaic.* E. S. SCHULTZ, REINER BONDE and W. P. RALEIGH, United States Department of Agriculture.

2. *Growing Seed Potatoes under an Aster Cage.* DONALD FOLSOM, University of Maine.

3. *Stimulation of Potatoes by Magnesium Bordeaux Spray.* REINER BONDE, Maine Agricultural Experiment Station.

4. *The Effect of Varying the Concentration and the Lime to Copper Ratio in Bordeaux Mixture in Potato Spraying.* E. O. MADER, New York State College of Agriculture.

5. *Field Experiments on Potato Scab Control in Western New York.* C. F. TAYLOR, New York State College of Agriculture.

6. *Soil Treatments with Mercurials for Control of Potato Scab.* C. W. FRUTCHLEY and J. H. MUNCIE, Michigan Agricultural Experiment Station.

7. *Soil Treatment in the Control of Certain Potato Diseases.* D. J. MACLEOD, Dominion Laboratory of Plant Pathology, Fredericton, Canada.

8. *Fertilizer-Mercury Combinations for the Control of Potato Scab and Rhizoctonia.* WM. H. MARTIN, New Jersey Agricultural Experiment Station.

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5. *The Activities of the International Commission for the Study of the Potato.* (15 min.) WILLIAM STUART, United States Department of Agriculture.

6. *The Effect of Soil Reaction on the Potato Plant.* (15 min.) ORA SMITH, Cornell University.

7. *Some Observations on the Sprout Development of Potato Tubers Exposed to Low Temperatures.* (20 min.) (Lantern.) R. R. HURST and H. L. MACLAREN, Charlottetown, Prince Edward Island.

8. *New Varieties of Potatoes.* (15 min.) F. J. STEVENSON, United States Department of Agriculture.

Friday Afternoon Session, December 29, 2:00 P. M.; Room E-390, Biological Laboratories.

1. *Potato Digger Equipment and Operation in Relation to Mechanical Injury.* (15 min.) E. V. HARDENBURG, Cornell University.

2. *Wire Worms and Their Injuries to the Potato.* (15 min.) G. F. MACLEOD, Cornell University.

3. *The Response of Potatoes to Magnesium Under Various Soil Conditions.* (20 min.) T. E. ODLAND and H. C. KNOBLAUCH, Rhode Island State College.

4. *Magnesium in Potato Fertilizers in Aroostook County, Maine.* (15 min.) J. A. CHUCKA, Maine Agricultural Experiment Station.

5. *Fertilizer Studies on Long Island.* (15 min.) P. H. WESSELS, Long Island Vegetable Research Farm, Riverhead, Long Island, New York.

6. *Fertilizer Placement Studies with the Potato in 1933.* B. E. BROWN, United States Department of Agriculture.

Maine—J. A. Chucka, Agricultural Experiment Station.
Michigan—C. E. Millar, Agricultural Experiment Station.
New Jersey—Wm. H. Martin Agricultural Experiment Station.
Ohio—John Bushnell, Agricultural Experiment Station.
Virginia—W. O. Strong, Virginia Truck Experiment Station.

Saturday Morning Session, December 30, 9:30 A. M.; Room E-390, Biological Laboratories.

1. Business Meeting, Report of Committees and Election of Officers.

2. *Potatoes Under Drouth Conditions.* (15 min.) DANIEL DEAN, Nichols, New York.

3. *The Cooperative Marketing Plan in Maine.* (15 min.) FRANK HUSSEY, Presque Isle, Maine.

4. *Developments in the Marketing of the Ohio Potato Crop.* (15 min.) E. B. TUSSING, Ohio State University.

5. *Cooperative Marketing as Applied to Agriculture.* (15 min.) J. W. BOULTER, Prince Edward Island, Canada.

6. *Marketing the New Jersey Potato Crop.* (15 min.) WM. H. MARTIN, New Jersey Agricultural Experiment Station.

7. DISCUSSION. *Adjusting Potato Production to Consumption Needs.*

Saturday Afternoon Joint Session with American Phytopathological Society, December 30, 1933, at 2:00 P. M.; Lecture Room, Biological Laboratories, Harvard University.

1. *Components of Potato Mild Mosaic.* E. S. SCHULTZ, REINER BONDE and W. P. RALEIGH, United States Department of Agriculture.

2. *Growing Seed Potatoes Under an Aster Cage.* DONALD FOLSOM, University of Maine.

3. *Stimulation of Potatoes by Magnesium Bordeaux Spray.* REINER BONDE, Maine Agricultural Experiment Station.

4. *The Effect of Varying the Concentration and the Lime to Copper Ratio in Bordeaux Mixture in Potato Spraying.* E. O. MADER, New York State College of Agriculture.

5. *Field Experiments on Potato Scab Control in Western New York.* C. F. TAYLOR, New York State College of Agriculture.

6. *Soil Treatments with Mercurials for Control of Potato Scab.* C. W. FRUTCHLEY and J. H. MUNCIE, Michigan Agricultural Experiment Station.

7. *Soil Treatment in the Control of Certain Potato Diseases.* D. J. MACLEOD, Dominion Laboratory of Plant Pathology, Fredericton, Canada.

8. *Fertilizer-Mercury Combinations for the Control of Potato Scab and Rhizoctonia.* WM. H. MARTIN, New Jersey Agricultural Experiment Station.